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A Field Measurement Device for the Aerosols Used in Mosquito Control

What do we do in aerial mosquito control

Where we were going wrong in the past

New machinery and the field droplet sizing method developed for this new equipment

Mosquito Control

- The intent is to produce a ULV spray which then drifts through the target zone
- We do not want the pesticide concentrate to deposit out under the spray line

Applications Methods In Brief!

- To increase mosquito control and reduce ground deposits the correct parameters must be met:
  - Droplet size for impaction of the flying mosquito
  - Meteorology to move the spray through the target zone
  - Altitude effects both of the above
    - Helicopter 150ft 15µm VMD
    - Fixed wing 300 ft VMD 25µm

The Primary Parameter

- Droplet size dictates how far it will drift; therefore, how long the droplet will be air borne for impaction upon a mosquito;
- Best droplet size for impaction upon a mosquito is 5-25μm.

Measuring Droplet Size

- In the laboratory, we now use a high speed wind tunnel (capable of 150mph wind speeds) and a Malvern laser system (purchased 2000)
- In the field we need to collect the droplets on a surface
- The very small droplets that we produce are very difficult to capture and in the past data returned has been inaccurate

Inaccuracies

- Inaccuracies were due to two things: the SAMPLER and the POLY-DISPERSE nature of the spray
- Because our drops are small a correction factor was developed for the low collection efficiency of these drops;
- For drops with diameters below 30µm, collection efficacy increases directly with the square of the diameter;
- Therefore when calculating volume (D^3) one can divide D^3/D^2. This corrects for the reduced collection efficacy of small drops (Yeomans 1945).

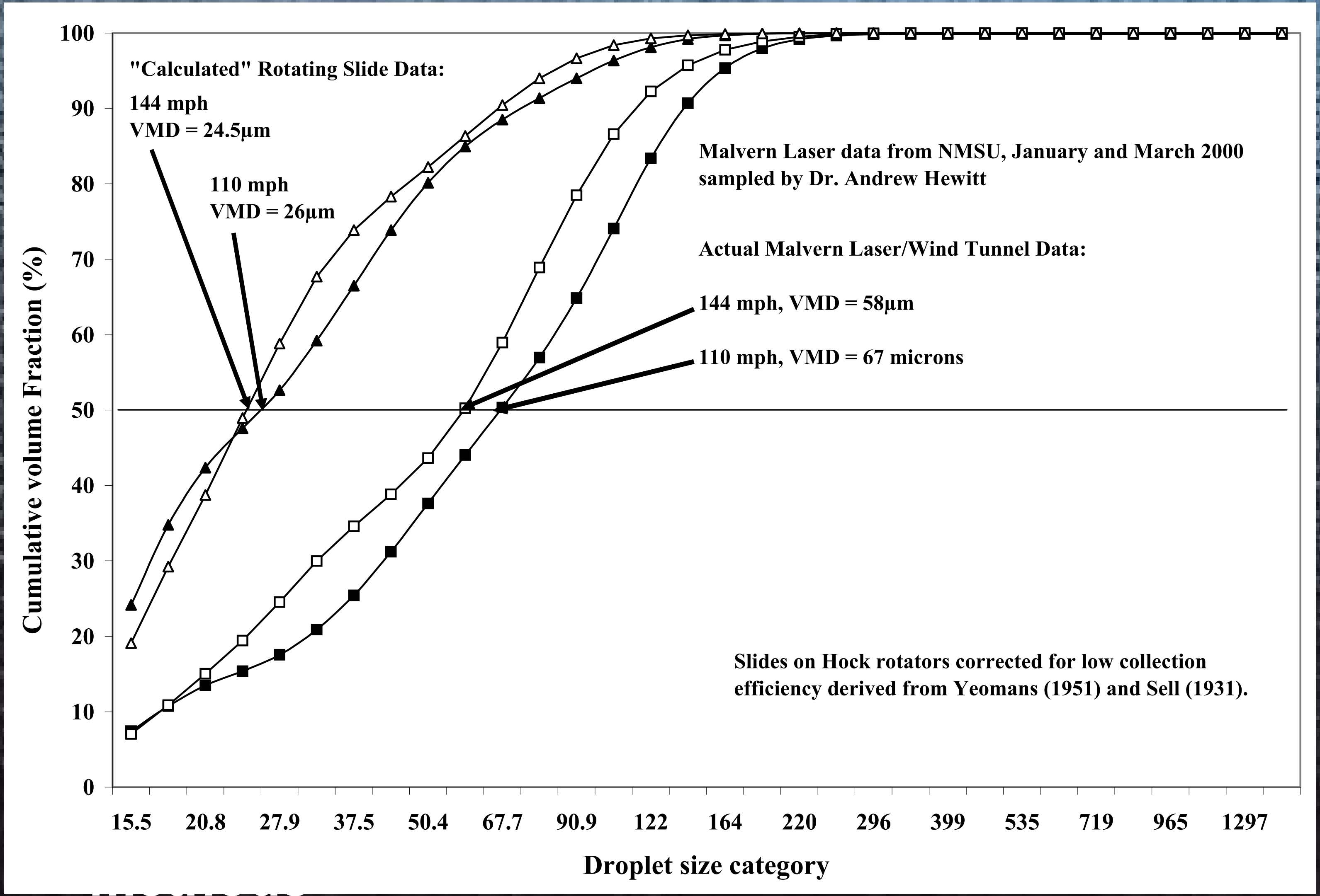
Good for Ground Equipment

- This correction works well for the ground ULV systems because they has small narrow drop spectrums (below 30µm) and was a generally accepted method
  - Then we began to apply our chemical by air

Aerial Applications

- The nozzle systems used (flat fans) produced a poly-disperse spray compared to the ground ULV systems;
- The majority of drops were over 30 µm and the linear response of collection efficacy to diameter was therefore lost.
- This meant that the effect of larger drops within the spray was not accounted for when D (Yeomans 1945) not D^3 was used to measure the spray;
- This resulted in an underestimation of the droplet size distribution.

Our underestimation



The Old sampler

- The impingers used to collect droplets in the previous studies were Hock impingers rotating the 2.5-cm wide slide at 3 m/s.
- It was postulated that if the rotational speed was increased and the slide size reduced then a slightly more accurate sample of droplet size distribution would be taken.

Hock Sampler

New sampler

- 3 mm slides were fabricated from extruded acrylic bars
- Bars were coated with FEP (Teflon) tape
- The fabricated slides were positioned 18 cm apart on threaded nylon rod.
- Holes were drilled for the slides and nylon nuts screwed in on the outer edge to hold the slides in position.
- A third hole was drilled in the center to attach the rod arm to the motor. The DC motor rotated at 590 rpm generating 5.6 m/s at the slide.

PHEREC impinger

The systems being tested

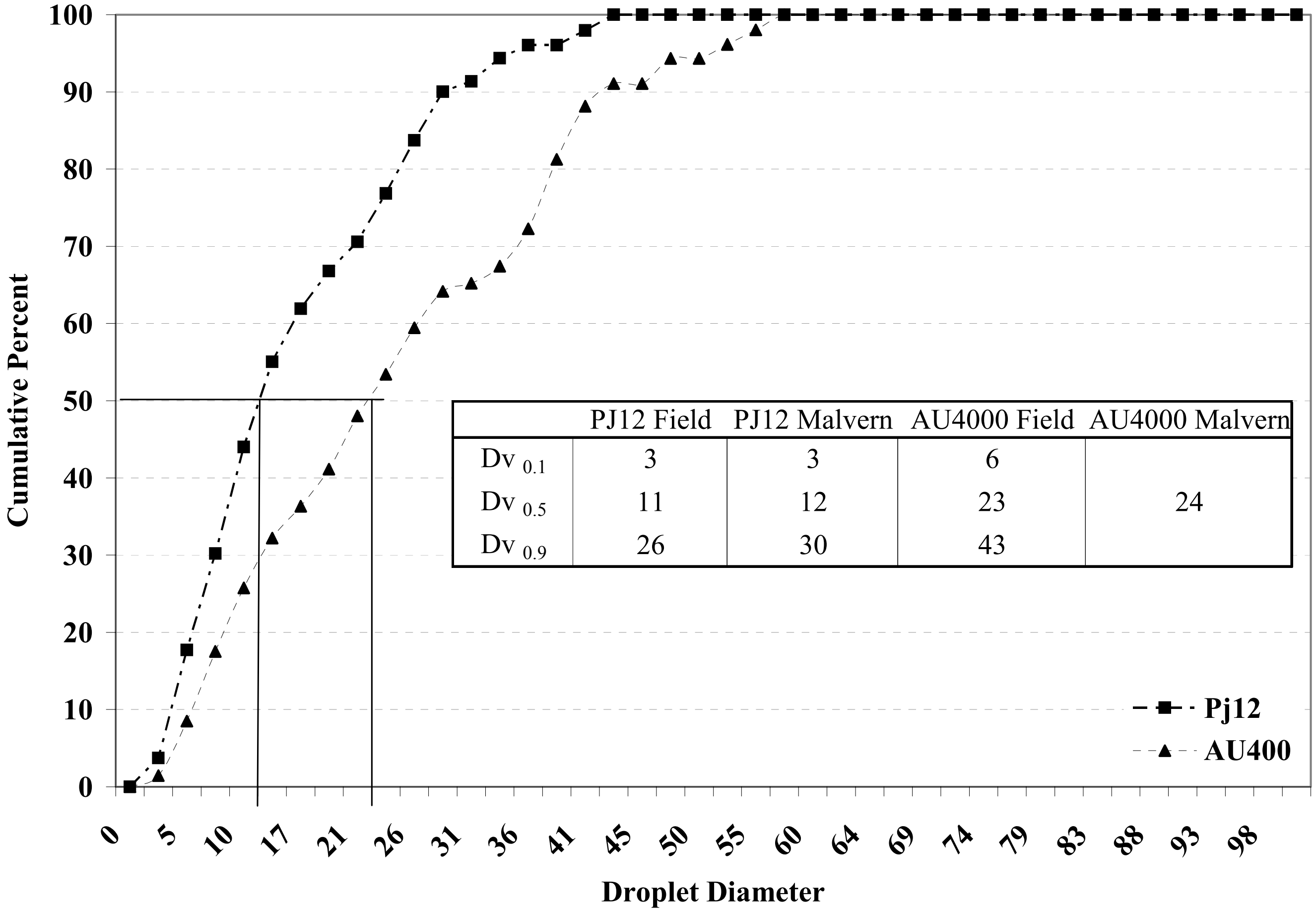
- Two Micronair AU4000 nozzles were fitted to a DC3 with a forward speed of 67.1 m/s (150 mph), a loaded rotational speed of 10,000 rpm at a 43º blade pitch and applying 2.3 L/min (80 oz/min).
- PJ12 impinger nozzles (Bete nozzles, Thomas Agency, Winter Park, FL) were placed on another DC3 aircraft flown at 69.2 m/s (155mph). The spray pressure was 19.3 MPa (2808 psi) and the flow rate was 0.47 L/min (16 oz/min).

Drop Calibration Flights

- For droplet sizing in mosquito control
  - A low emission height 12-15 m (40-50 ft) to minimize the loss of the ultra fines.
  - flying into the wind,
  - Samplers are then organized considering the nozzle positioning
  - Slides are then boxed up and read within two hours due to the volatility of the tracer;

Results Field vs. Laboratory

- The new field sampler provides a representative measure of the spray cloud.



	PJ12 Field	PJ12 Malvern	AU4000 Field	AU4000 Malvern
Dv $_{0.1}$	3	3	6	
Dv $_{0.5}$	11	12	23	24
Dv $_{0.9}$	26	30	43	

Conclusions: field drop sizing

- A field sampler has been developed for mosquito control which provides a representative measure of the spray cloud.
- It is simple and inexpensive to make $30
- This device/technique however is only relevant to those applicators that have moved to smaller emission spectra ($DV_{0.5}$'s of 12-30 µm)
- As more aerial applicators move towards smaller droplet producing systems this device in conjunction with the Yeomans correction should be recommended as a field measuring system.
- This sampler is not applicable for measuring "conventional flat fan spray systems" sprays with $DV_{0.5}$'s in excess of 50 µm.

- Its also an active sampler so when one conducts research in low wind regimes it will buffer the effects of wind speed change hence collection efficiency change between site and experiments

Thank you for your time

Questions?